

CONTACT POINTS

Curt White
Carbon Sequestration Science
Focus Area Leader
National Energy Technology
Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236
412-386-5808
curt.white@netl.doe.gov

AN INVESTIGATION OF GAS/WATER/ROCK INTERACTIONS & CHEMISTRY

- Develop reservoir or basin scale models that include flow, mass transport, and chemical reaction processes for CO₂ injection and field pilot test sites.

Accomplishments

The facilities to conduct hydrothermal CO₂-water-rock reactions and analyze these complex mixtures have been developed at NETL. Work on the systematic study of the solubility of CO₂ in increasingly complex salt solutions is currently underway.

In addition to construction of a database containing physical and chemical information on over 64,000 brine wells, NETL has added information on the locations of coal-fired power plants and information on seismic activity. A composite map depicting the power plants, saline formations, and seismic potential was constructed. The high-pressure chemistry of CO₂ with brines sampled around the nation has been started. The pertinent reactions have been identified and the effect of temperature, pressure, pH, and other variables determined. Lastly, several simulations of brine field sequestration have been developed. These include development of sophisticated reservoir models as well as reactive transport models.

Benefits

This project will provide useful information in the area of reaction kinetics dealing with carbon dioxide and surrounding minerals and also provide a compiled brine database of some 64,000 brine wells in the United States. By compiling a database of these brines along with power plants and seismic activity in the United States, a more efficient means of storage can take place in optimal locations. Taking nearby power plant emissions and local seismic activity into consideration, researchers and engineers become more informed as to where precautions need to be taken or simply where areas of higher risk are located. Thus, an understanding of the fundamental chemistry associated with the reactions coupled with a detailed brine database provides much needed information and efficiency to the actual sequestration projects. Additionally, by capturing carbon dioxide and sequestering it, harmful emissions into the atmosphere are prevented that may further increase global warming.

PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Sequestration

08/2002

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Background

About two thirds of the United States is underlaid by deep saline aquifers that have an estimated CO₂ adsorption capacity of between 320 to 10,000 billion tons. Unfortunately, there are a large number of uncertainties associated with the heterogeneous reactions which may occur between CO₂, the brine, and minerals in the surrounding strata—especially with respect to reaction kinetics. This project focuses on the complex solution and surface chemistry of CO₂ in brines in the presence of host rock and the special types of analyses required to study the reaction kinetics. Carbonate mineral formation/dissolution reactions that may be important in geologic sequestration in deep saline aquifers will be identified. The kinetics of CO₂ dissolution in the liquid phase and subsequent substrate-water reactions are slow and poorly understood. Understanding the kinetics of both these types of reactions and the processes controlling them is essential to understanding the conversion of CO₂ into stable carbonate minerals.

A compilation of existing brine data from a variety of sources, and a complete statistical analysis of the brine chemistry and other geological parameters associated with brine aquifers would be a valuable tool for both experimental and modeling studies of CO₂ sequestration in brines. Currently, NETL is developing a brine database that includes temperature, depth, pressure, and a variety of chemical variables (pH, sodium, iron, chloride, bicarbonate, calcium, magnesium, sulfate, and total dissolved solids) on some 64,000 brines taken from the contiguous United States. Sources of these data include those provided by the USGS, searches of geoscience literature, State Geological Surveys and oil and gas producing companies. Additionally, NETL has instituted a limited field program of brine collection throughout the United States. This brine sampling is being done in conjunction with other government agencies and oil and gas companies.

Primary Project Goal

The ultimate objective of the work being performed jointly at NETL and the United States Geological Survey is to carry out an experimental study to assess the role of the chemistry of formation water in CO₂ solubility. Then the role of rock mineralogy in determining the potential for CO₂ sequestration through geochemical reactions will be assessed.

Objectives

- Investigate kinetics of CO₂ dissolution in brines at temperatures and pressures appropriate for deep saline aquifer carbon dioxide sequestration.
- Improve the understanding of the processes by which mineral carbonates are formed and study the reactivity of various mineral substrates involved in these processes.
- Assess and collect both brines and surrounding geologic strata in selected brine formations in the conterminous United States in order to determine their potential to sequester CO₂ from fossil fuel fired power plants.

PRIMARY PARTNERS

National Energy Technology
Laboratory
United States Geological Survey
Parsons Power
Battelle Memorial Institute
University of Pittsburgh
California University of
Pennsylvania
University of Texas
Case Western Reserve
University

DOE FUNDING PROFILE

| | |
|------------|-----------|
| Prior FY's | \$682,000 |
| FY2002 | \$817,000 |
| Future FY | TBA |

TOTAL ESTIMATED COST

| | |
|-----|-------------|
| DOE | \$1,499,000 |
|-----|-------------|

CUSTOMER SERVICE

800-553-7681

WEBSITE

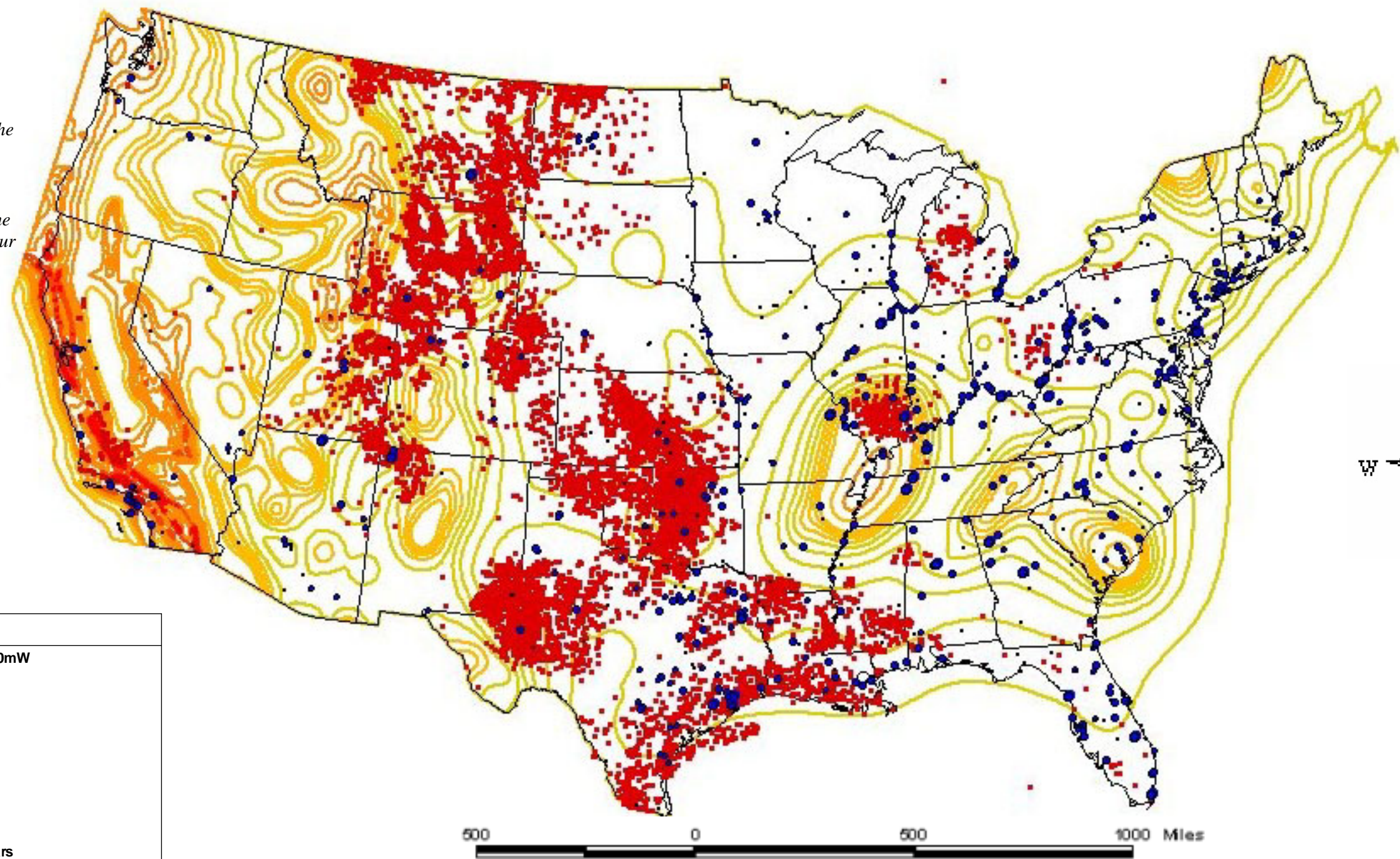
www.netl.doe.gov



GEOLOGIC SEQUESTRATION OF CARBON DIOXIDE

Powerplant Locations • Brine Well Locations • Seismic Potential

The black circles on the map indicate the location of the fossil fuel fired power plants. The size of the black circles is proportional to the megawattage of the power plant. The gray areas indicate the location of brine wells, while the contour lines indicate seismic potential.



LEGEND

Power Plants Nameplate Capacity ≥ 100 MW

- 100 - 420 MW
- 421 - 875 MW
- 876 - 1469 MW
- 1470 - 2242 MW
- 2243 - 3969 MW

US States

US Counties

Brine Wells

Peak Ground Acceleration,
10% Probability of Exceedance in 50 years

0 - 6 ft/sec/sec

7 - 15 ft/sec/sec

16 - 40 ft/sec/sec

41 - 60 ft/sec/sec

61 - 100 ft/sec/sec

Albers Equal Area Projection

Clarke 1866 Spheroid

Central Meridian -96.0

Reference Latitude 37.5

2nd Standard Parallel 45.5

Power generation data derived from EPA Billion and Generation Resource Database 1998 (E-GRDB) and DOE/BA 787.
Geological coverage derived from data originated under DOE/ETL contract by the University of Texas, Bureau of Economic Geology.
DRAFT by Garrett Velez DRAFT